

Neurology and neurologic practice in China

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ABSTRACT

In the wake of dramatic economic success during the past 2 decades, the specialized field of neurology has undergone a significant transformation in China. With an increase in life expectancy, the problems of aging and cognition have grown. Lifestyle alterations have been associated with an epidemiologic transition both in the incidence and etiology of stroke. These changes, together with an array of social issues and institution of health care reform, are creating challenges for practicing neurologists throughout China. Notable problems include overcrowded, decrepit facilities, overloaded physician schedules, deteriorating physician-patient relationships, and an insufficient infrastructure to accommodate patients who need specialized neurologic care. Conversely, with the creation of large and sophisticated neurology centers in many cities across the country, tremendous opportunities exist. Developments in neurologic subspecialties enable delivery of high-quality care. Clinical and translational research based on large patient populations as well as highly sophisticated technologies are emerging in many neurologic centers and pharmaceutical companies. Child neurology and neurorehabilitation will be fast-developing subdisciplines. Given China's extensive population, the growth and progress of its neurology complex, and its ever-improving quality control, it is reasonable to anticipate that Chinese neurologists will contribute notably to unraveling the pathogenic factors causing neurologic diseases and to providing new therapeutic solutions. *Neurology*® 2011;77:1986-1992

GLOSSARY

AD = Alzheimer disease; **MS** = multiple sclerosis; **tPA** = tissue plasminogen activator; **VaD** = vascular dementia.

THE EVOLUTION OF NEUROLOGY IN CHINA The birth and development of neurology and neurologic practice in China well mirror the country's modern history despite some barriers paired with quite dramatic advancements. Distinctive periods for the development of neurology as a separate scientific entity and changes in neurologic practice began in China during the 1920s to 1930s. In this so-called cradling period, a Department of Neurology was established in Beijing as an independent entity where the science and diseases of the nervous system were taught.¹⁻⁴ The concept of modern neurology, like other medical disciplines, was introduced by a prominent neurologist from Philadelphia, Andrew H. Woods, at such institutions as Peking Union Medical College and set in motion the country's early neurologic practice.¹⁻⁴ In addition, a number of physicians who received part of their medical training in Europe, the United States, and Canada returned home to become elite Chinese neurologists and neurosurgeons. Many of these experts headed neurology services in centers at Beijing, Tianjin, Shanghai, Changsha, and Nanjing. Students who were trained in and graduated from these centers later effectively led neurologic practice in China. Despite the interruptions of World War II and subsequent civil war, by the early 1960s, neurology centers grew to exceed 1,000 beds where dedicated neurologists served across the country. In the postwar era, that is, since mid 1950, medical education in China was strongly influenced by Russia. In 1952, the Chinese Association of Neurology and Psychiatry was established, and in 1955, the *Journal of Chinese Neurology and Psychiatry* was published.²⁻⁴ This trend stimulated a significant expansion of neurology that endured until 1966. However, during 1966-1976, encompassing the Cultural Revolution, the practice of neurology was in part merged into that of internal

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medicine, which marginalized neurologists and their specialization. Publication of their only academic periodical was suspended; all such academic activities were cancelled, and the development of neurology ceased.²⁻⁴

But starting in 1976, China turned sharply to a new direction. By opening many new sectors of endeavor, the government built a thriving enterprise with unique features that distinguished it from its Western counterpart. Economic growth in China over the next 2 decades achieved a 10-fold increase in gross domestic product, a speed and strength that unfolded despite several periods of shrinkage in the global economy. The impact of such a booming economy on health-related issues in China is multi-fold. Hundreds of millions of people have progressed out of poverty. The lifestyle of its 1.3 billion people changed markedly, generally for the better. However, environmental dilemmas such as air and water pollution became a new and common health threat, as the spectrum of diseases across many medical disciplines consequently shifted. Epidemics of sexually transmitted disease, substance abuse, obesity-related diabetes, long-term cigarette smoking, heart attacks, and mental health problems related directly to the new environment and behaviors. Toward overall betterment, though, a number of societal issues such as medical ethics and institution of health care reform emerged. Among the potent implications of these social changes that so greatly altered the expectations and practical values of the Chinese population is the reality that the profession of medicine will never be the same as before, nor will the physician–patient relationship in either practical or ethical terms. The demand for quality care is a force for change of the health care system as is the presumption of premium medical research. We discuss how these myriad economic, environmental, social, and behavioral changes in the last 3 decades affect current neurologic practice in China and, in some attributes, are compared to Western practice.

GROWTH OF NEUROLOGY AND NEUROLOGIC PRACTICE IN CHINA The recent 30-year 3- to 5-fold increase of neurologic patients seen as well as numbers of practicing neurologists has kept pace with rapid urbanization in China’s major cities. It is notable that other disciplines within and outside internal medicine also grew during that period but on a much smaller scale. The reasons behind such disproportionate growth of neurology are somewhat complex, possibly reflecting the perception by patients as well as some physicians that such illnesses can be managed only by specialists. Typically, then, patients with neurologic problems would be concentrated in

large hospitals. In addition, with the increased mobility and access to information, more people would seek medical services in large centers where famous neurologists are available. For example, one of China’s largest neurologic centers, Beijing Xuan Wu Hospital, recorded 24.6 million neurology office visits between 2001 and 2006. In 2009 alone that number increased to 25.2 million; currently, daily office visits exceed 1,300. A significant proportion of these patients are from broad areas of China. Conversely, neuroimaging and other neurodiagnostic tools such as CT scanners, MRI, PET scanners, and EEG monitoring systems are now readily available in every major hospital. This widespread access to sophisticated equipment may lead to recognition of more neurologic problems than before and the likelihood that some are confused with other medical conditions.

EPIDEMIOLOGIC TRANSITION OF STROKE, A MAJOR NEUROLOGIC DISEASE IN CHINA The major causes of death in China are vascular disease, cancer, and chronic respiratory disease. In fact, and unlike in Western countries, cerebrovascular disease predominates. The number of Chinese people who die from stroke is more than 3 times that from coronary heart disease. Here, we contrast some unique features of stroke in China and the West (table 1). Despite the limited data on stroke incidence and prevalence, some interesting trends have emerged regarding the etiology of stroke in China. In a 21-year observational study from the Sino-MONICA-Beijing project, a total of 14,584 stroke events was registered in the study population from 1984 through 2004. During that time, the incidence of hemorrhagic stroke declined by 1.7%; however, the annual incidence of ischemic stroke increased by 8.7% on average.⁵ Therefore, this brief 2-decade interval, which encompasses a period of economic development, might be associated with the epidemiologic transition of this cerebrovascular disease⁵ (table 1).

The number of hospital admissions for stroke in China is similar to that of other developed countries.⁶ However, elsewhere, average hospital stays are

Table 1 Stroke in China and the West

Age-adjusted first-ever stroke in China is not very different from that in Western countries
Epidemiologic transition in China since the 1990s: hemorrhagic stroke 1.7% ↓ ; ischemic stroke 8.7% ↑
Stroke is the predominant inpatient service in China, but has never been so in the West
Difference in perceptions of disease severity, early mobilization, availability of neurorehabilitation facilities, necessity for institutional long-term care, costs of hospital stay

2–4 weeks, whereas Chinese hospitals reported a 36% longer average stay⁶ than in the United States. Fewer neurorehabilitation facilities and a smaller number of physical and occupational therapists in Chinese hospitals may in part account for such differences. Additionally, insurance policies that dictate the length of hospital stay also differ in the 2 countries. Yet, most Chinese perceive any motor deficiency as a very severe condition, requiring lengthy hospital stays and repeated IV infusions. A good many neurologists and patients in China view these time-consuming requirements as more important than either early mobilization and functional recovery or treatment with tissue plasminogen activator (tPA) within the first 4.5 hours of stroke symptoms. Early treatment may include administration of urokinase or snake venom, which are more affordable than tPA and are commonly used in China.⁶ For urokinase, a national multicenter 95's Project conducted in China showed promising results.⁶

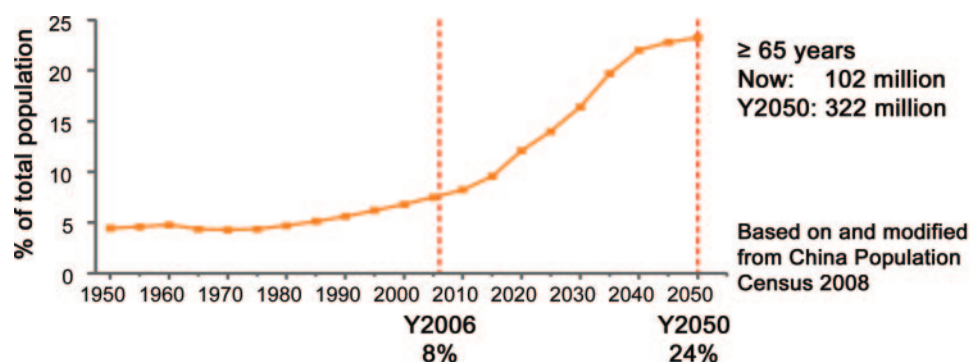
Although the regimens of Western medicine are the mainstay for prevention and treatment of stroke in China, some of these patients are treated with one or more types of Chinese herbals or acupuncture. Similarly, myriad types of “neuroprotective agents,” such as cerebral protein hydrolysate and deproteinized calf blood, are being used at various stages of stroke management, but without proven efficacy.

NEUROLOGIC PROBLEMS ARISING FROM STRESS Changes in lifestyle along with industrialization have created a new era of stress in many working Chinese. As a result, patients' neuroses, headaches, and neuropsychological problems are rapidly growing issues confronting neurologists. Some argue that changes in the way that mental illness is diagnosed might explain its rise. In any case, *Nature* reported that Eli Lilly, one of several providers of mental health drugs in China, has seen rapid growth in sales of antidepressant and antipsychotic drugs,

both exceeding \$200 million annually.⁷ According to a survey published in 2009, 17.5% of the Chinese population has some form of mental illness, one of the highest rates in the world.⁷ In comparison, a World Health Organization survey found that the United States had the highest prevalence of mental illness in the world, with 26.4% of the population thought to have a diagnosable disorder in any given year.⁷ Regardless of the frontrunner, mental illness is now firmly on the list of national health concerns in China, prompting researchers, drug companies, and medical practitioners to develop new initiatives to tackle the issue as quickly as possible. Moreover, attention to depression and cognitive impairment in patients with neurologic disorders is being recognized as an important issue that is equal in significance to management of motor and sensory neurologic deficits.

NEUROLOGIC PROBLEMS ARISING FROM AGING The former perceptions of aging common to Asians differed considerably from those in Western cultures. But now, as opposed to the centuries-long tradition of familial care for the aged, today's senior citizens in China live far longer than their predecessors, and the family unit neither remains intact nor is numerous enough to provide for them. As illustrated in the figure, by 2050, individuals over 65 years of age in China will reach 322 million, roughly corresponding to 1/5 of the total population. Consequently, patients with long-term neurodegenerative disorders such as Alzheimer disease (AD) and Parkinson disease will increase significantly. Practicing neurologists and policy makers are encountering alarming evidence that the infrastructure is not sufficient to accommodate this aging population in China either within or outside of hospital settings. Most of these patients will be managed and followed up in outpatient clinics; however, neither cognitive centers nor neurologists are plentiful enough to cope

Figure Aging Chinese populations



Percentage of older adults (age 65+) in China, 1950–2050.

with the already burgeoning problems of multiple cognitive disorders in China.⁸ In contrast to Western cultures, many Chinese perceive cognitive decline as a normal part of the aging process, so they are reluctant to seek diagnosis and management of such problems. Moreover, aged patients often expect their children to assume the traditional obligations of housing and caring for them, as few nursing homes exist. However, with implementation of the one-child per family policy for many decades in China, the number of parents who need care exceeds the number of children. The rapid rate of urbanization and skyrocketing real estate prices also contribute to the tendency toward small families, so that children cannot exercise such responsibilities even if they wish to do so. The fast pace of life and work-related pressure as well as the high cost of medical care contrast sharply with China's ideal of harmonious society, so unique models are needed to bridge that ideology with today's reality.

Inevitably, dementia will be one of the main disorders associated with disability, institutionalization, and mortality in the elderly of China, as in the West. Studies that included only a few Chinese communities and cities in 1980 to 2005^{9,10} found that the prevalence of dementia of all types approximated 3% to 5% for people aged 65 years and older. AD and vascular dementia (VaD) were the 2 main subtypes of dementia, and the prevalence rates were 2% to 3.5% and 0.9% to 1.1%, respectively. A recent survey encompassing large areas of China documented prevalence rates of 5.1% for dementia, 3.2% for AD, and 1.5% for VaD in a population aged 65 and older. These rates differed significantly between rural and urban populations.^{11,12} Moreover, the overall prevalence of mild cognitive impairment in subjects 65 years old and older was 20.8% in China,^{11,12} a striking number that is helpful for planning a rational public health program.

CHALLENGES FACING PRACTICING NEUROLOGISTS IN CHINA The array of problems facing Chinese neurologists ranges from changes in the disease spectrum and emerging ethical and social issues to infrastructure and current policies (table 2).¹³⁻¹⁵ In many situations, intrinsic problems (massive patient population) and man-made problems (abuse of medical insurance, distrust between neurologists and their patients) can intermingle and aggravate each other. The practice of defensive medicine by some neurologists significantly impairs efficient practice.

In spite of the changing spectrum of neurologic diseases, the subspecialties have not yet developed sufficiently even in many university hospitals. Chinese neurologists, the majority of whom are not en-

Table 2 Challenges facing neurologists in China

Infrastructure
Overcrowded outpatient and hospital facilities
Diagnostic and treatment options are influenced to by patient status
Lack of research space and support in many neurologic centers
Heavy clinical load
Underdeveloped primary care
Wrong incentives for seeing more patients
Social issues
Lack of mutual trust between physicians and patients
Patients and media express skepticism and suspicion
No legislation to protect doctors/nurses
Medical professionals undervalued by society

gaged in subspecialty practices, must cope with a general range of afflictions that includes multiple types of stress from aging and emerging neurologic diseases seldom before confronted. Additionally, the traditional neurology department undoubtedly faces adjustments to significantly expanded office-based services, including but not limited to management of chronic conditions, e.g., those remaining from cerebral vascular diseases as well as long-term treatment of disabilities derived from neurologic diseases.

The institution of major health reform and health insurance in China starting several years ago has significantly impacted the medical field in general but certainly neurologic practice in particular. What once dictated a patient's management plan was economic status, which varied depending on education, income, job, and geographic location. Now the insurance plan plays an ever greater role in formulating a course of treatment. In general, as a result of health care reform, more people have access to neurologic services. To varying extents, insurance covers office- and inpatient-based services as well as the mainstay diagnostic procedures, medications, and follow-up therapies.¹⁶ Compared to other countries, China's physician services, medication, and even surgical procedures are still relatively inexpensive, rendering insurance plans generally affordable to patients, their employers, and corresponding governmental agencies.

Even that advantage has not evaded challenging problems, though, since shortly after the implementation of medical insurance, China has seen its abuse. Fake claims and identity theft promotes the payment of benefits to users of false names. Conversely, rumor has it that insurance agencies sometimes deny reimbursement, for no apparent reason. When such an incident occurs, physicians or the hospital they serve must pay the fees, a grievous consequence.

With regard to medical insurance, the situation for relatively rare neurologic conditions such as multiple sclerosis (MS) is quite different. Based on limited epidemiologic studies, the prevalence of MS in mainland China is estimated at 1.39/100,000 persons, much lower than in adjacent regions such as Hong Kong, Taiwan, Japan, and South Korea (5–10/100,000).^{17–19} Although there is no apparent reason for a lower MS presence in mainland China compared with adjacent regions, the actual number of such patients is not fewer given China's large population base. For management of acute relapses, steroids, plasma exchange, and IV immunoglobulin are available. Disease-modifying drugs, such as RebifTM, BetasersonTM, and rituximab, are on the market. However, none of these drugs is currently covered by insurance, and their cost is well beyond the means of ordinary Chinese citizens. Presently, though, several companies have developed strategies to include some of these drugs in insurance plans as early as 2014.

OPPORTUNITIES FOR NEUROLOGIC INNOVATION IN CHINA

In contrast to the United States, where the initial enthusiasm for training and certification in some neurologic subspecialists appears to have slowed,^{20,21} the dramatic growth of the neurologic field will ultimately lead to a clear distinction between general neurologists and the subspecialists. The leading interest in China is, of course, development of a stroke program. Stroke units have been established in nearly every hospital; in some cases, comprehensive stroke centers encompass components for medical and intravascular intervention, rehabilitation, and stroke education/prevention. New programs such as the Center for Neuroinflammation in the General Hospital, Tianjin Medical University, are emerging. Providing state-of-the-art specialized service for patients and scientific excellence are equally emphasized with notable results.^{22,23} The importance of neurorehabilitation and child neurology is also being realized as manifested in the establishment of such departments in some centers. Development of these subspecialties not only facilitates the delivery of high-quality patient care but also creates openings for the requisite physicians.

Along with the birth of these large neurologic centers in China, opportunities for translational research are on the near horizon.²⁴ Indeed, an array of exciting prospects awaits neurologists and neuroscience researchers as well as developers of related industrial products (table 3).²⁴ Chinese neurologists and neurosurgeons are among the earliest to adapt neural stem cell research into translational applications for such conditions as amyotrophic lateral sclerosis, cerebral palsy, and MS, among others. The

Table 3 Opportunities for neurology and neurologic practice in China

Government investment in health care infrastructure
Promotion of research and increased funding
Accumulation of intellectual pool: homegrown and repatriated
Large and growing patient population
Less cost for clinical trials
Less vigorous regulation for clinical trials
Development of medical professionals trained in leadership

absence of randomized, double-blind, and multicenter trials has prevented the acceptance of these approaches outside China. Moreover, the lack of transparency to define the origin of stem cells and the procedures for their manipulation further cloud the use of these therapies. However, in 2009, the Chinese Ministry of Health implemented regulations for clinical applications of stem cell injections. Institutions wishing to offer stem cell therapies must first demonstrate safety and efficacy in clinical trials; then the treatment is assessed by a ministry-approved regulator²⁵ but is available after validation.

Although most Chinese hospitals are state owned, private hospitals with their own funding sources or in joint ventures are now allowable. In view of this expanding market for products that contribute to the care of neurologically affected patients in China, several global pharmaceutical companies including GSK Shanghai have established in-country research complexes. That decision has been driven by a growing number of experienced scientists who are returning to their homeland from the United States and Europe²⁴ and the desire to establish neurology centers where the spirit and energy of the local workforce are obvious. The industrial applications related to the enlarging interest in neurologic well-being and health offer stunning opportunities in China.

EDUCATION OF NEUROLOGISTS IN CHINA

Preceding the opportunity to practice medicine in China, most high school graduates devoted to such a career enter medical school directly and graduate in 5 years with an “MD degree,” or to be accurate Bachelor of Medicine. A general college education is not required to prepare students for medicine, although some colleges emphasize studies in biology or biochemistry with additional curriculum and timeline of 2 to 3 years (so called 7- or 8-year program). Hospitals in China are graded into 3 levels based on an accreditation system that was established in 1989. Level 3 hospitals with 500 beds and more corresponding tertiary care university hospitals in the United States account for roughly 2% of all 62,000 public medical facilities in China.⁴ Standard training

of neurologists as well as many other disciplines of medical science includes a defined 3- to 4-year curriculum, with specialized clinical rotations in internal medicine, neuroimaging, various aspects of neurology, and some electives in level 3 hospitals. Institutes that qualify for the training of neurologists must meet specific criteria set by professors of neurology and the Ministry of Public Health. Additionally, guidelines are in place to establish requirements for passing examinations, acquiring a license to practice and setting salary levels. However, such examinations are designed for general practitioners of medicine and are not specific for neurologists. So far, there do not appear to be any entrance examinations (such as US Medical License Examinations) or neurology residency-matching processes like those in the United States. Candidates for a neurology residency are often recruited from university hospitals or sent by regional hospitals.

The Neurology PhD program in China is a 3-year curriculum that offers additional or adjunct training of neurologists with emphasis on either clinical or research skills. These PhD programs differ from those of fellowship training in the United States and elsewhere in that the training provides little input on any one subspecialty. Practicing in neurology, in general, attracts high-quality medical graduates, indicating the great potential for this evolving field in China.

FUTURE PROSPECTS We caution that the rise in neurology practice and neurologic disorders in China calls for well-defined direction, pace, and quality control. Like China's successes in industrialization and economic benefits, the development of a world-class comprehensive program in neurology absolutely requires a network of well-organized clinical, research, and educational programs as well as rehabilitation centers, electronic medical record facilities, and specialized agendas for child and aged populations. The inclination to use multiple medications that dilute mainstay therapy should be curbed. Long-term follow-up on patients must be given sufficient priority to really increase neurologists' experience over the years. Inappropriate incentives as part of China's fee-for-service payment system have resulted in rapid cost increases, inefficiency, poor quality/unaffordable health care, and an erosion of medical ethics. Realignment of incentives for neurologic care providers should not be delayed so that trust between neurologists and patients can be restored. Although many academic neurologic centers rush to embrace the subspecialty movement, the mass production of PhD graduates trained for research cannot provide personnel adequate to supply fundamental patient

care. To meet that need, accredited neurology fellowship training programs must be in place.

Further, the long-term viability of basic neurologic practice and its newly developed subspecialties will depend upon strong governmental support for the new health care era in China. In terms of research and development, Chinese neurologists—investigators have a grand opportunity to make the most of their large patient populations and sophisticated neurodiagnostic tools for the conduct of translational studies. Traditional Chinese medicines may hold the secret to assembling a collection of pure molecules from medicinally important plants as a basis for alleviating disease. Inevitably, because of the newly advancing opportunities both technological and financial, it is reasonable to forecast that Chinese neurologists will contribute to the understanding of disease pathogenesis and therapies throughout the world.²⁶⁻²⁸

AUTHOR CONTRIBUTIONS

Drs. Shi and Jia codeveloped the major theme and content of this article; they share equal responsibility for surveying the literature, interviewing neurologists, visiting sites, and writing the manuscript.

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